1-1-1971

Peterborough Quadrangle

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TRIP A-2

PETERBOROUGH QUADRANGLE _/

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General Discussion

This trip will provide a cross section of the southeast limb of the Merrimack synclinorium by means of a northerly and, finally, westerly traverse across the Peterborough quadrangle (figure 1). The four members of the Littleton Formation recognized in this area (Greene, 1970) will be observed, along with the major types of plutonic rocks.

At New Hampshire's south boundary, that part of the Merrimack synclinorium occupied by the Littleton Formation is only about 24 miles wide. The beds strike predominantly north-northeast. Southeast of a line through Crotched Mountain and Mount Monadnock, dips are predominantly northwest; northwest of this line they are mostly southeast; thus the synclinorial axis is defined.

In the Peterborough quadrangle, analysis of bedding strike and dip and of fold axes and axial planes shows that the southeast limb of the Merrimack synclinorium is a relatively simple homoclinal sequence in which beds get younger to the northwest. It is complicated, however, by numerous minor folds. Fold axes mostly trend northeast and plunges are gentle northeast, horizontal, or, less commonly, gentle southwest. Axial planes dip vertically to 60° northwest.

As there are no major folds smaller than the Merrimack synclinorium, the sequence of units across the Peterborough quadrangle is nonrepetitive.

_/ Publication authorized by the Director, U.S. Geological Survey

It is as follows:

Littleton Formation:	
Crotched Mountain Member_/	5,320 feet
Francestown Member_/	80 feet
Peterborough Member_/	13,055 feet
Souhegan Member_/	6,460 feet

These thickness figures were derived from a calculation utilizing structure diagrams (Greene, 1970, p. 36-40). The units will be examined from the base up, starting in the Massabesic Gneiss of Sriramadas (1966) (Stop 1) a mixed rock derived in part from the Souhegan Member. The Souhegan Member will be seen at Stop 2; Peterborough Member at Stops 5, 6, and 7; the Francestown Member at Stop 8; and the Crotched Mountain Member at Stop 9.

Schist and granulite consisting predominantly of quartz, plagioclase, muscovite, and biotite with minor garnet and sillimanite are the principal rocks of the Souhegan, Peterborough, and Crotched Mountain Members. All are metamorphosed to sillimanite grade.

Major intrusive rocks are the Spaulding Quartz Diorite (Stop 3), Kinsman Quartz Monzonite (Stop 10), and binary quartz monzonite (Stop 3). All belong to the New Hampshire Plutonic Series. Rocks in each unit range through several steps in the sequence quartz diorite, granodiorite, quartz monzonite, granite. Quartz diorite generally contains plagioclase, quartz, and biotite, whereas the others contain plagioclase, microcline, quartz, muscovite, and biotite.

_/ Of Greene (1970)

REFERENCES CITED:

Fowler-Billings, Katharine (1946) Geology of the Monadnock region of New Hampshire: Geol. Soc. America Bull. 60, 1249-1280.

Greene, R. C. (1970) Geology of the Peterborough quadrangle, New Hampshire: New Hampshire Dept. Resources and Econ. Devel. Bull. 4, 88 p.

Hitchcock, C. H. (1874, 1877, 1878) Geology of New Hampshire: 3 volumes and atlas, Concord, N. H.

Moore, G. E., Jr. (1949) Structure and metamorphism of the Keene-Brattleboro area, New Hampshire-Vermont: Geol. Soc. America Bull. 60, 1613-1669.

Sriramadas, Alura (1966) Geology of the Manchester quadrangle, New Hampshire: New Hampshire Dept. Resources and Econ. Devel. Bull. 2, 78 p.

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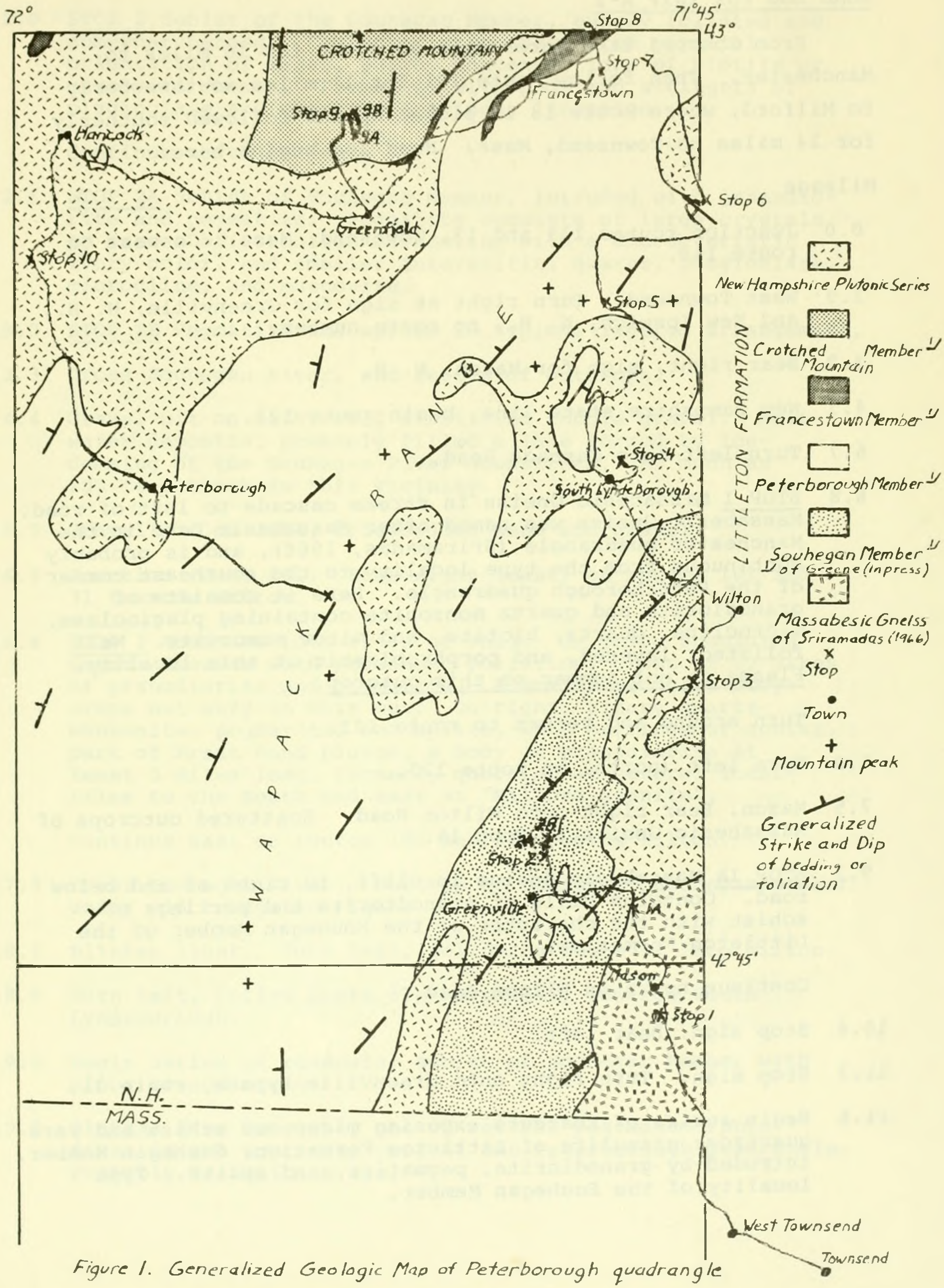

Figure 1. Generalized Geologic Map of Peterborough quadrangle

ROAD LOG FOR TRIP A-2

From Concord take Interstate 93 south for 16 miles to Manchester. Then follow Route 101 for 11 miles southwesterly to Milford, where Route 13 is picked up and followed southerly for 14 miles to Townsend, Mass. Road log begins here.

Mileage

0.0 Junction routes 119 and 13, Townsend, Mass. Go west on route 119.

1.9 West Townsend. Turn right at sign for Greenville, N. H., and New Ipswich, N. H., no route number.

3.2 Bear right, sign for Mason, N. H.

4.3 New Hampshire state line, begin route 123.

6.7 Turn left onto Cascade Road.

6.8 STOP 1 Massabesic Gneiss in stream cascade to left of road. Massabesic Gneiss was named after Massabesic Lake in the Manchester quadrangle (Sriramadas, 1966), and is probably continuous from the type locality to the southeast corner of the Peterborough quadrangle. Here it consists of granodiorite and quartz monzonite containing plagioclase, microcline, quartz, biotite, and minor muscovite. Well foliated, layered, and porphroblastic at this locality. Please do not hammer on this outcrop.

Turn around and return to route 123.

7.0 Turn left (north) on route 123.

7.5 Mason. Bear right onto Wilton Road. Scattered outcrops of Massabesic Gneiss to Stop 1A.

9.2 STOP 1A Massabesic Gneiss in cliff, to right of and below road. Contains sills of granodiorite and partings of schist with the character of the Souhegan Member of the Littleton Formation.

Continue north on Wilton Road.

10.4 Stop sign. Bear left.

11.3 Stop sign. Turn right onto Greenville Bypass, route 31.

11.6 Begin series of roadcuts exposing micaceous schist and rare quartzose granulite of Littleton Formation, Souhegan Member, intruded by granodiorite, pegmatite, and aplite. Type locality of the Souhegan Member.

Milcage

12.0 STOP 2 Schist of the Souhegan Member, evenly foliated and somewhat banded. Characteristic sheen from parallel orientation of micas, patchy concentrations of biotite or muscovite common. Permeated with pods and stringers of plagioclase and quartz. Prominent lineation.

Continue north on route 31.

12.6 STOP 2A Schist of Souhegan Member, intruded with granodiorite and pegmatite. Pegmatite consists of large crystals or masses of perthitic microcline with a characteristic ivory color, and smaller interstitial quartz, plagioclase, microcline, and muscovite.

13.0 STOP 2B Pegmatite and aplite in typical layered arrangement.

13.3 Cross Souhegan River, end series of outcrops.

14.4 Gravel pit on left, well stratified cobble gravel. Meltwater deposits, probably filled a lake formed by ice-damming of the Souhegan River downstream. As much as 200 feet thick in this vicinity.

15.2 Gravel pit on left, crossbedded sand and gravel.

16.2 Junction route 101. Bear right (east) on routes 101 and 31 towards Wilton.

16.8 STOP 3 Roadcuts both sides of road. On left, Spaulding Quartz Diorite with prominent foliation, crosscut by dikes of granodiorite and pegmatite. A small, elongate body; crops out only in this cut. On right, binary quartz monzonite, pegmatite, and aplite, with partings of schist, part of Pratt Pond pluton, a body of granodiorite at least 5 miles long, formerly quarried at several localities to the south and east as "Milford granite".

Continue east on routes 101 and 31 towards Wilton.

17.4 Cross Souhegan River. Outcrop of schist of Souhegan Member under old bridge to right.

18.2 Blinker light. Turn left, following route 31 into Wilton.

18.6 Turn left, follow route 31 (northeast) towards South Lyndeborough.

19.0 Begin series of roadcuts; schist of Souhegan Member with minor granodiorite.

19.5 Diabase dike on right, one of several postmetamorphic dikes in the southeast part of the Peterborough quadrangle. Probably Triassic in age.

Mileage

19.7 Roadcuts from here on are foliate Spaulding Quartz Diorite and pegmatite. A small body similar to the one observed at stop 3.

19.9 Railroad crossing, End series of outcrops.

20.0 Cross Stony Brook. Bear right, continue northeast on route 31.

22.2 South Lyndeborough, railroad crossing. Turn sharp right.

22.3 Keep left.

22.5 Keep left.

22.8 Turn left onto dirt road.

23.1 STOP 4. Quarry in white quartz rock of silicified zone. Elongate bodies of quartz rock are aligned in two bands across east-central part of Peterborough quadrangle. The bodies are probably connected by faults, which by analogy with silicified zones in the Keene quadrangle (Moore, 1949), are probably Triassic normal faults. Quartz rock quarried here is crushed and used for decorative purposes, such as exposed aggregate.

Turn around and return to South Lyndeborough.

23.9 South Lyndeborough, same point as 22.2 miles. Bear right, continue north on route 31.

24.4 Turn right at sign for Lyndeborough Center.

25.6 Junctions, keep right.
25.7
25.9
26.2 Pond on right.

26.9 Turn left, paved road.

27.2 Badger Pond on right.

27.5 Junction. Go Straight ahead.

27.6 View of Wapack Range. Seen are, south to north, Temple, Pack Monadnock, North Pack Monadnock, Winn, and Lyndeborough Mountains.

Mileage

28.7 STOP 5. Top of rise, large mailbox on right, house beyond. Roadcut on left, several outcrops near house; please do not hammer on these. Lane to right, later path leads to open blueberry pastures with many glacially smoothed outcrops of schist of the Littleton Formation, Peterborough Member, also granodiorite and pegmatite. Schist is of both granulitic and micaceous types, commonly with garnet and (or) sillimanite. Excellent bedding in several places, grading not seen. This is one of the summits of Lyndeborough Mountain. Here the Wapack Range bends sharply from northeast to east to southeast trending. This is not reflected in the strike, however, which remains dominantly northeast. Continue in same direction (north) after stop.

29.9 Pavement ends. The north slope of the Wapack Range is here, as elsewhere, largely covered with drift. From here to 31.0 the road crosses several drumlins whose long axes are all close to N. 30° W.

30.0 Junction, turn right.

31.3 Junction, bear left.

31.7 Gravel pit on left, crossbedded sand and gravel (outwash).

32.0 T-Junction, paved road. Turn left.

32.2 Junction. Turn left (northwest) toward Francestown.

32.7 Turn right onto sand road, sign for Clark Hill Farm.

33.1 STOP 6. Bridge over Piscataquog River. Granodiorite upstream; severely retrograded schist of Littleton Formation, Peterborough Member, downstream. Dark-green schists consist mostly of muscovite, partially to wholly converted to chlorite. Unusual northwest strike with southwest dip.

Bear left after crossing bridge and continue north.

33.4 Cross paved road, continue straight ahead.

34.9 Outcrop of quartz=plagioclase granulite, part of a small lentil of volcanic rocks separately mapped in this area.

35.2 Haunted Lake on the left. From here to 36.4, road goes between several prominent drumlins. Axes are all close to N. 20° W.

35.6 Junction, keep left.

36.8 T-Junction, paved road, turn left (west).

37.3 Turn right, paved road, sign for soapstone quarry.

Mileage

37.7 STOP 7 Soapstone quarry. Hitchcock (1878) reports soapstone was discovered here in 1794 and first worked in 1802. The material was used for stoves, sinks, and washboards, and became quite famous for its high quality. The soapstone consists of talc, phogopite, tremolite-actinolite, and chlorite. Wallrocks are mostly normal schists of the Littleton Formation, Peterborough Member, but a few transitional rocks are also found. Thick brush and poison ivy; use care. Most accessible for collecting are blocks of soapstone on the north side of the quarry.
Straight ahead after stop.

38.2 STOP 8 Roadcut and natural exposures of rusty granulite of the Littleton Formation, Francestown Member. Granulites consist mostly of quartz and plagioclase; some also contain muscovite, others actinolite and clinozoisite. Weathering of pyrite gives an extremely rusty surface and, commonly, a sulfurous odor. This unit was mapped as the Rusty Quartzite Member of the Littleton Formation in the Monadnock quadrangle (Fowler-Billings, 1949).

Go straight after stop. Roadcut exposures continue, also natural exposures in cuestalike ridges to left.

38.5 End exposures, turn around.

39.2 Turn right onto gravel road.

40.1 T-Junction, paved road, turn right.

41.0 Francestown. Bear left, follow route 136 towards Greenfield.

44.6 Swamp on right. Crotched Mountain Center on bluff above.

45.4 Greenfield. Turn right onto route 131, then turn right again, continuing on route 131.

46.1 Outcrops of Kinsman Quartz Monzonite to right. This is the easterly trending "hook" at the south end of the Cardigan pluton.

46.2 Turn right, sign for Crotched Mountain Center.

46.7 Nashua Fresh Air Camp on right. Exposures of interfingering schist and quartz monzonite in contact area.

46.8 Rusty granulite in roadcut on right.

47.7 STOP 9 Turn right toward Crotched Mountain Center and stop. Outcrops of schist of Littleton Formation, Crotched Mountain Member, across road. Some of the schist contains the large sillimanite porphyroblasts that distinguish the Crotched Mountain Member.

Go straight after stop.

48.1 STOP 9A Driveway to main buildings of center. Outcrops on left are well-bedded schist and granulite of Crotched Mountain Member with sillimanite and garnet porphyroblasts. View southwest to Mount Monadnock, south to Pack and North Pack Monadnock Mountains, southeast to Winn and Rose Mountains and Joe English Hill and east to Uncanoonoc Mountains.

Bear left continuing on main loop road.

48.8 STOP 9B Outcrop on left is rusty quartzose schist. Trail on right leads 1.8 miles to summit of Crotched Mountain. Outcrops of schist abundant for first three-fourths and last one-half miles. Near summit much of the schist has large aligned porphyroblasts of sillimanite. Type area of Crotched Mountain Member..

49.0 Junction, end of loop road. Go straight, toward Greenfield.

50.4 Stop sign. Turn left.

51.2 Greenfield. Turn right on route 136.

51.8 Bear right, sign for Hancock. Between this point and route 31 to north is a complex area of drift and outwash with kettle holes.

54.5 Covered bridge, Contoocook River.

55.7 Junction route 202. Go straight.

56.2 Bear left.

56.7 Junction route 123. Bear right. Outcrops of schist (a large inclusion) and quartz monzonite on right between here and 57.3.

57.3 Hancock. Bear left following route 123.

57.5 Turn left onto route 137.

57.9 Bear left onto Middle Road.

59.3 Turn right.

Mileage

60.2 STOP 10 Halfmoon Pond spillway. Built by the Army Engineers to divert flood waters to the Contoocook River below Peterborough. Glacially polished outcrops of Kinsman Quartz Monzonite. Large phenocrysts of microcline are flow aligned and later sheared. Outcrops slope towards water---use caution.

Go straight after stop.

60.6 Junction, road right to Sargent Camp. Go straight ahead. Outcrops of more "normal" Kinsman Quartz Monzonite to left and ahead to 61.1.

63.9 West Peterborough. T-Junction, turn left.

65.5 Peterborough, corner of Grove Street. A building here plus many foundations and retaining walls in Peterborough are made of a highly foliated binary granodiorite quarried across the Contoocook River only one-half mile south of here. This granodiorite is similar in composition to less foliated granodiorites in other parts of the quadrangle but has undergone cataclasis.

65.6 Cross Contoocook River, turn right.

66.3 Junction route 101. Turn left (east), toward Wilton and Milford.

70.0 Gap in Wapack Range between Pack Monadnock and Temple Mountains. Temple Mountain ski area to right. Road left leads 1.2 miles to Miller State Park at the top of Pack Monadnock Mountain. Abundant outcrops of schist, granite, and pegmatite along road and at summit; type area for Peterborough Member of Littleton Formation.

End of road log.